First Canadian records of *Lampropteryx suffumata* ([Denis & Schiffermüller], 1775) (Geometridae: Larentiinae)

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ABSTRACT

The first Canadian records of the Holarctic species *Lampropteryx suffumata* ([Denis & Schiffermüller], 1775) are documented, based on collections from Alberta and British Columbia. Widespread and common throughout much of Eurasia, the larvae feed on *Galium* species (Rubiaceae). Diagnostic descriptions and images are provided to aid in future recognition of this species. The specimens were originally detected while constructing a DNA barcoding library for western North American Geometridae, and provide a good example of how genetic methods can enhance the construction of regional inventories and aid in surveillance for invasive species.

Key Words: *Lampropteryx suffumata*, black-banded carpet, DNA barcoding, invasive species

INTRODUCTION

The genus *Lampropteryx* Stephens includes ten species, most of which are restricted to Asia, with two species also occurring in Europe (Scoble 1999). The black-banded carpet *Lampropteryx suffumata* ([Denis & Schiffermüller], 1775), described from Vienna, Austria, occurs from western Europe and the northern Mediterranean region to northern Scandinavia, east through the Tien Shan and Altai mountain ranges of south-central Asia to the Kamchatka Peninsula, Russia and Hokkaido, Japan (Skou 1986; Beljaev and Vasilenko 2002). Previously known in North America only from Alaska (Choi 2000), we report here historical and contemporary records in British Columbia and Alberta, flagged by DNA barcoding.

MATERIALS AND METHODS

During the course of documenting the molecular diversity of western Canadian geometrid moths from museum and field collections using standard DNA barcoding methods (Hajibabaei *et al.* 2005; deWaard *et al.* 2008), it became evident that a number of specimens variously identified as *Antepirrhoe* Warren or *Xanthorhoe* Hübner were highly divergent compared to other congeners. Using the identification engine of the Barcode of Life Database (BOLD) (Ratnasingham and Hebert 2007), their cytochrome oxidase I (COI) sequences were a nearly identical match to those of *Lampropteryx suffumata* ([Denis & Schiffermüller], 1775) specimens from Bavaria, Germany

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(Figure 1). Although many larentiines are very similar in habitus and are difficult to identify when the wing pattern is worn, subsequent genitalic examination of the suspect *Antepirrhoe* and *Xanthorhoe* specimens showed unequivocally that they are in fact *L. suffumata.*

To determine the Canadian distribution, and whether or not the species is likely native, we examined historical and contemporary *Antepirrhoe* and *Xanthorhoe* specimens from various Canadian collections. We identified specimens in the Royal British Columbia Museum, Victoria, BC (RBCM), the E.H. Strickland Entomological Museum, University of Alberta, Edmonton, AB (UASM) the Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, ON (CNC), and the Biodiversity Institute of Ontario, University of Guelph, Guelph, ON (BIOUG) as *L. suffumata.* The collections of the Pacific Forestry Centre, Canadian Forest Service, Victoria, BC (PFCA), the Spencer Entomological Museum, University of British Columbia, Vancouver, BC (UBCZ), and the Northern Forestry Centre, Canadian Forest Service, Edmonton, AB (NFRC) do not contain any specimens of *L. suffumata.*

RESULTS

Specimens examined (all specimens are single, pinned adults; the BOLD accession number (italicized) is provided for specimens that have been barcoded).

AB: Hillcrest, 49.568N 114.377W, 20-vi-1919 (K. Bowman) [UASM, UASM10792]; West Castle River, W Castle R. Rd., 15 km SW, 49.294N 114.273W, 23-v-1999 (B.C. Schmidt) [CNC, CNCLEP00033310, *GWNC311-07*]; **BC:** Elkford, 35 km north, 50.266N 114.921W, 12-Jun-1988 (C.S. Guppy) [RBCM, ENT991-006550, *GWNR470-07*]; Glacier National Park, Abandoned Rails Trail west of Rogers Pass Centre, 51.2902N 117.516W, 04-Jul-2005 (K. Pickthorn) [BIOUG, HLC-20568, *LBCA568-05*]; Glacier National Park, Glacier National Park Compound at Rogers Pass, 51.3032N 117.519W, 28-Jun-2005 (K. Pickthorn) [BIOUG, HLC-20320, *LBCA320-05*]; Glacier National Park, Illecillewaet Campgrounds west of Rogers Pass, 51.2648N 117.494W, 24-Jun-2005 (K. Pickthorn) [BIOUG, HLC-20175, *LBCA175-05*]; Glacier National Park, Glacier National Park Compound at Rogers Pass, 51.3032N 117.519W, 16-Jun-2005 (K. Pickthorn) [BIOUG, HLC-20022, *LBCA022-05*]; Trinity Valley Field Station, 50.400N 118.917W, 18-May-1961 (W.C. McGuffin) [CNC, CNCLEP00054030].

Identification. A medium-sized, broad-winged moth with a wingspan of 2.5–3.2 cm (Figure 2a.). The forewing basal and median bands are dark, varying from red-brown to black, being dark brown in most specimens. The median band has a jagged proximal and distal margin, with the distal margin extending towards the base just below the median area, such that the median band is narrower along the anal third than on the upper half. The apex is also darkened, divided by a white apical dash. There is a subterminal line of white spots or wedges, and the fringe is checkered. It is very similar to *Antepirrhoe semiatrata* (Hulst), but can be readily separated by the following characters: forewing pale antemedian band faintly bordered with two whitish lines both proximally and distally (only one pale border line in *A. semiatrata*); forewing subapical dark patch bordered towards costal margin by contrasting pale line (indistinctly so in *A. semiatrata*). The dorsal markings on the abdomen are the most reliable external features for diagnosing *L. suffumata*, which has a row of black triangles along the midline (Fig. 2a), whereas *Antepirrhoe* species have two black dots broken at the midline by a pale line/spot. Some specimens may be melanic and lack the contrasting white forewing bands present in most specimens. *Xanthorhoe* species are superficially similar, but lack the combination of broad, dark

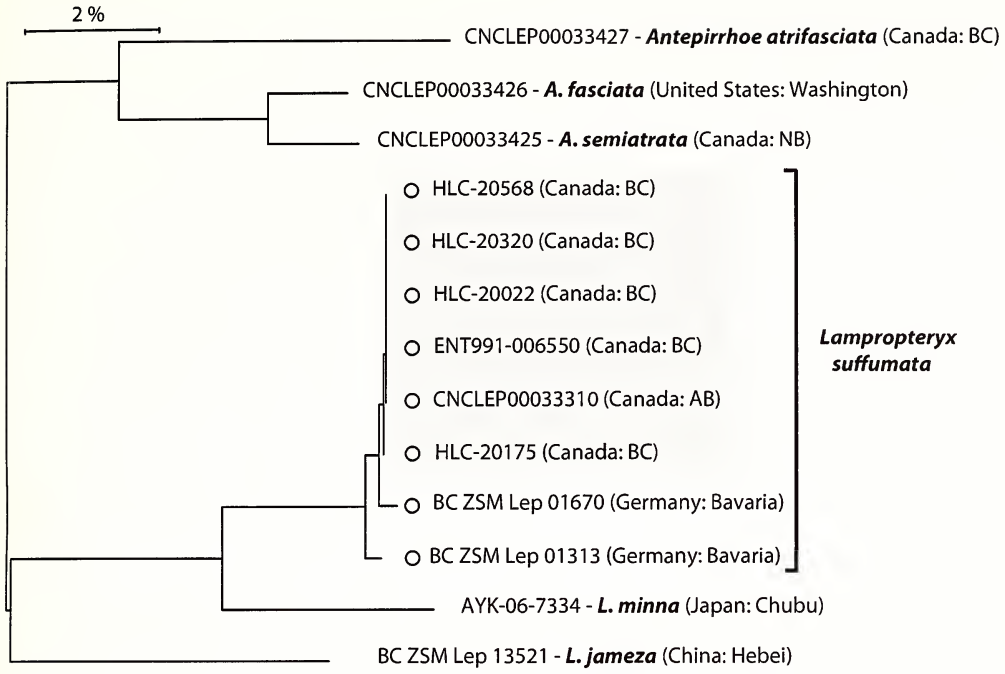

Figure 1. Neighbour-joining tree of *Lampropteryx suffumata* and related species. Tree was reconstructed with the barcode fragment of the COI gene. Sequences shaded in grey are derived from specimens previously misidentified as *Antepirrhoe* or *Xanthorhoe* spp. The 13 sequences are publicly available in the Barcode of Life Database and GenBank (accession nos. FJ376631–FJ376643).

basal and median bands with a contrastingly bordered subapical dark patch that extends to the distal wing margin. Genitalic examination of *L. suffumata* will easily segregate this species: the male valve is simple and lobe-shaped, costa lacking apical process; socii prominent, about half as long as valve, with bundle of apical setae as long as socius; aedeagus uncurved, vesica with two cornuti (Figure 2b,c.). Identification through genitalic examination of males can usually be made by brushing away the terminal abdominal scales to reveal the apical portion of the valve which lacks the pointed, dorsally projecting costal process of *A. semiatrata*, in addition to the long tubular socii (stout and triangular without apical hair pencils in *A. semiatrata*). Male genitalic structure of *Xanthorhoe* species is very different, with a comparatively massive costal process that extends beyond the valve apex and is variously enlarged, broadened and/or armed with spines.

Distribution and Habitat: Great Britain and northern Europe east to southern Siberia, Kamchatka and Japan (Skou 1986; Beljaev and Vasilenko 2002); in North America, known from two areas: Alaska (Choi 2000) and southwestern British Columbia and adjacent Alberta (Figure 3). It is likely that this species occurs in intervening regions of northern British Columbia and the Yukon, but these areas have not been adequately surveyed. The single historical collection from Hillcrest, Alberta, coupled with the fact that *L. suffumata* occurs in relatively remote, mountainous habitats but has not been recorded near the international shipping ports of the coastal Pacific Northwest, suggests that *L. suffumata* is native to Canada. Furthermore, it likely expanded over Beringia during the Pleistocene, a common pattern in the western Canadian arthropod fauna, as evident by present ranges and fossil evidence of past ranges (Danks et al. 1997). Its habitat appears to be open wooded areas, edges and meadows.

Life History and Notes: There is a sin-

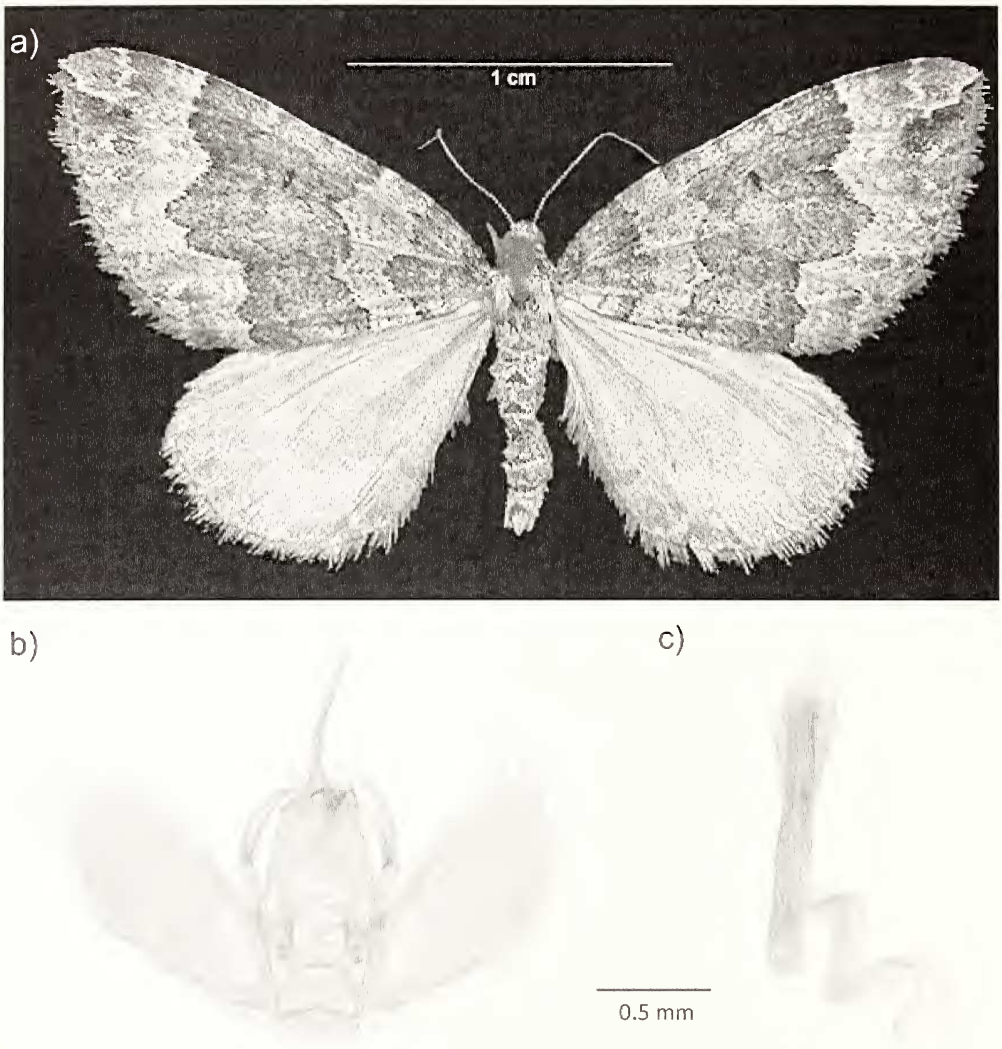

Figure 2. Adult male of *Lampropteryx suffumata*: a) dorsal view b) genital capsule c) aedeagus.

gle annual brood, with adults in late May to early July. Adults are nocturnal and come to light. The only reported larval hosts are bedstraw species (*Galium* sp.), particularly *G. aparine* Linnaeus (Skou 1986). The pupa overwinters underground (Skou 1986). Based on the scarcity of specimens in Canadian collections, we conclude the species is rarely collected and likely rare. The COI barcode sequences are publicly available in the Barcode of Life Database and GenBank (accession nos. FJ376631–FJ376643).

DISCUSSION

The late discovery of a relatively large and conspicuous native macromoth in Western North America is surprising, but we believe it can be explained simply by the paucity of taxonomic expertise and literature on the group. The Canadian larentiines are notoriously hard to discriminate, due in part to the lack of a treatment of this

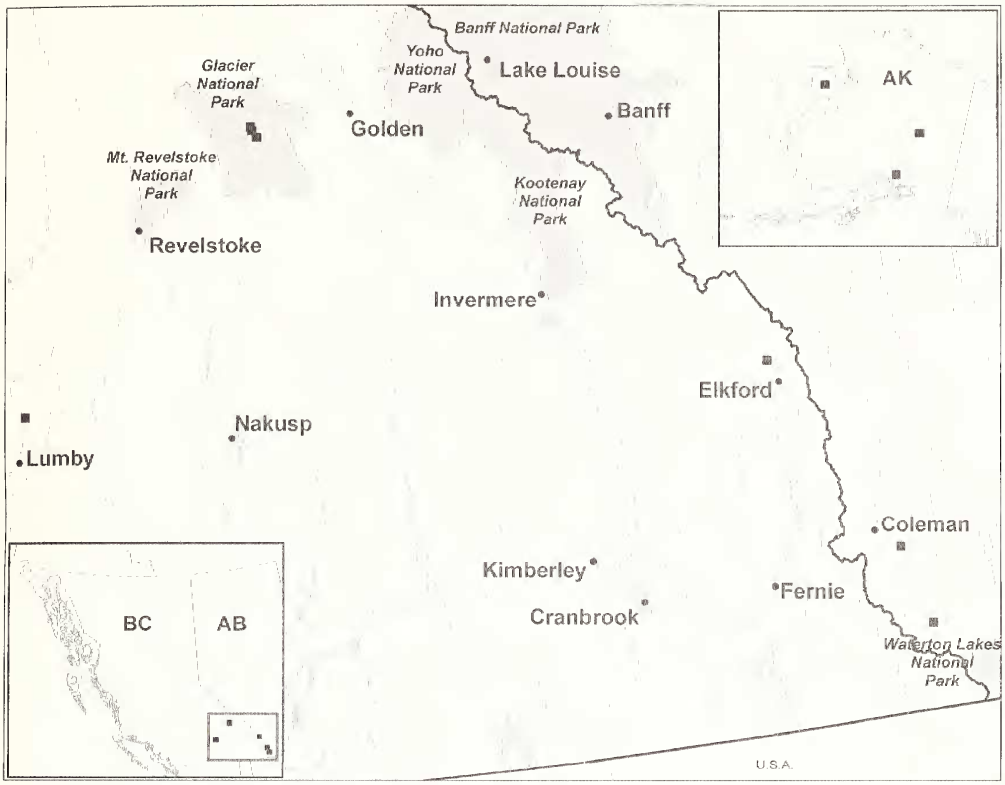

Figure 3. Distribution of *Lampropteryx suffumata* in North America. Black squares are locations of records.

subfamily in McGuffin's 'Guide to the Geometridae of Canada' series (1967, 1972, 1977, 1981, 1987, 1988). While a few larentiine genera have been revised (*Hydriomena* Hübner: McDunnough 1954; *Eupithecia* Curtis: Bolte 1990; *Entephria* Hübner: Troubridge 1997), most are in dire need of revision, and the Xanthorhoini in particular contain a number of genera that need attention, with cryptic and previously unrecognized species awaiting description (e.g., *Psychophora* Kirby, *Xanthorhoe* and *Zenophleps* Hulst: B.C.S. unpublished data; *Antepirrhoe*: J.R.D. *et al.* unpublished data). It is reasonable to assume that the few specimens of this rarely collected (and presumably rare) species could go unnoticed due to the lack of reliable guides and keys for the group.

Although *L. suffumata* is in all likelihood native, its discovery clearly illustrates how DNA barcoding can assist in the detection and surveillance of nonindigenous organisms (Armstrong and Ball 2005; Chown *et al.* 2008). A monitoring program that incorporates DNA barcoding can flag potential introduced species in one of two ways. First, as in this study, a barcode match is made with one or more specimens collected from the native range. The potential nonindigenous specimens can then be verified by morphological examination or further genetic analysis. At that point, national and regional collections can be examined for historical and contemporary specimens in the new range to determine if the species is native or introduced. Secondly, with a barcode library for a regional fauna complete (e.g., Geometridae of British Columbia – J.R.D. *et al.* unpublished data), any barcoded specimens that do not match the database are flagged as potentially nonindigenous and again warrant further examination. Using genetic methods for this initial screening has numerous advantages, most notably the ability to differentiate species objectively across all life stages as well as using damaged specimens. It is also ap-

parent that with the current costs of genetic analysis steadily dropping and new technologies emerging (Hajibabaei *et al.* 2007), genetic screening may soon be more cost- and time-efficient than current morphological methods of biodiversity monitoring.

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